MÜPRO

Europäische Technische Bewertung

ETA

für

MPC-Systemschienen

Centre Scientifique et Technique du Bâtiment
84 avenue Jean Jaurès
CHAMPS-SUR-MARNE
F-77447 Marne-la-Vallée Cedex 2
Tél. : (33) 01 64 68 82 82
Fax : (33) 01 60 05 70 37

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Europäische Technische Bewertung

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Allgemeiner Teil

Technische Bewertungsstelle, die Europäische Technische Bewertung ausstellt:
Centre Scientifique et Technique du Bâtiment (CSTB)

Handelsname des Bauprodukts:	MÜPRO MPC Systemschiene
Produktfamilie, zu der das Bauprodukt gehört:	Produkte für Installationssysteme für technische Gebäudeausrüstung
Hersteller:	MÜPRO Services GmbH Borsigstrasse 14 65205 Wiesbaden Germany
Herstellungsbetrieb:	UBB Umformtechnik GmbH Im Grund 1 91593 Burgbernheim Germany
Diese Europäische Technische Bewertung enthält:	59 Seiten, davon 56 Seiten Anhänge, die fester Bestandteil dieser Bewertung sind
Diese Europäische Technische Bewertung wird gemäß Artikel 95 Absatz 4 der Verordnung (EU) 2024/3110 auf der Grundlage von Folgendem ausgestellt:	European Assessment Document (EAD) 280016-00-0602
Diese Fassung ersetzt:	-

Spezifischer Teil

1 Spezifischer Teil

Gegenstand dieser Europäischen Technischen Bewertung sind die MÜPRO MPC Installationsschienen, die in Tabelle A1, bis Tabelle A6 beschrieben ist.

Die MÜPRO Schienen MPC 27/18L, MPC 27/18, MPC 28/30, MPC 38/24, MPC 38/40, MPC 39/52, MPC 40/60 und MPC 40/80 sind aus dünnwandigem Stahl in C-Form gefertigt. Aussparungen in Form von Langlöchern und Rundlöchern ermöglichen die Verwendung von Befestigungs- und Montagematerial.

Die MÜPRO Schienen MPC 38/48 H, MPC 38/80 H und MPC 40/120 H bestehen aus zwei Profilen des gleichen Typs, die im Bereich der Rückseite der Schienen form- und kraftschlüssig miteinander verbunden sind. Aussparungen in Form von Langlöchern und Rundlöchern ermöglichen die Verwendung von Befestigungs- und Montagematerial.

Die MÜPRO Schienen können entlang der gesamten Länge gemäß den Herstelleranweisungen zugeschnitten werden, ohne die angegebenen Leistungen zu beeinträchtigen.

Anhang A beschreibt die Zeichnungen, Abmessungen und Werkstoffe der MÜPRO Installationsschienen.

2 Spezifizierung des Verwendungszwecks gemäß dem anwendbaren Europäischen Bewertungsdokument

Von den Leistungen in Abschnitt 3 kann nur ausgegangen werden, wenn die MÜPRO Systemschiene entsprechend den Angaben und unter den Randbedingungen nach Anhang B verwendet wird.

Die Prüf- und Bewertungsmethoden, die dieser Europäisch Technischen Bewertung zu Grunde liegen, führen zur Annahme einer Nutzungsdauer der Schienen von mindestens 50 Jahren. Die Angabe der Nutzungsdauer kann nicht als Garantie des Herstellers verstanden werden, sondern ist lediglich ein Hilfsmittel zur Auswahl des richtigen Produkts in Bezug auf die angenommene wirtschaftlich angemessene Nutzungsdauer des Bauwerks.

Gemäß dem Europäischen Bewertungsdokument EAD 280016-00-0602 ist das Produkt unter der Voraussetzung vorgesehen, dass es in folgenden Bereichen verwendet, wird:

a) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von Komponenten ortsfester Brandbekämpfungssysteme,

b) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von technischer Gebäudeausrüstung im Allgemeinen,

c) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von Leitungen zum Transport von anderem Wasser als Trinkwasser,

d) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von Leitungen zum Transport von Gas/Brennstoff zur Versorgung von Heiz-/Kühlsystemen von Gebäuden

3 Leistung des Produkts und Angabe der Methoden ihrer Bewertung

3.1 Brandschutz (BWR 2)

No.	Wesentliches Merkmal	Leistung
1	Brandverhalten	Klasse A1
2	Abreißfestigkeit der Rücklochöffnungen der Schiene bei Brandbelastung	Keine bewertete Leistung
3	Biegeverhalten unter Brandeinwirkung	Keine bewertete Leistung
4	Spannungs-Dehnungs-Verhalten des Materials	Keine bewertete Leistung

3.2 Sicherheit bei der Anwendung (BWR 4)

No.	Wesentliches Merkmal	Leistung
4	Form	siehe Anhang A
5	Abmessungen	siehe Anhang A
6	Werkstoff und Querschnittseigenschaften	siehe Anhang A und B
7	Charakteristische Zugfestigkeit der Rücklochöffnungen der Schiene bei Umgebungstemperaturen	Keine bewertete Leistung

4 Für die Durchführung des Systems zur Bewertung und Überprüfung der Leistungsbeständigkeit erforderliche technische Einzelheiten gemäß anwendbarem Europäischen Bewertungsdokument

Gemäß dem Europäischen Bewertungsdokument EAD 280016-00-0602, gilt folgende Rechtsgrundlage:

- Im Falle der Voraussetzung a) gemäß Abschnitt 2:
  96/577/EC, geändert durch 2002/592/EC:
  Folgendes System ist anzuwenden: 1

- Im Falle der Voraussetzung a) gemäß Abschnitt 2:
  97/161/EC:
  Folgendes System ist anzuwenden: 2+

- Im Falle der Voraussetzung a) gemäß Abschnitt 2:
  1999/472/EC, geändert durch 2001/596/EC:
  Folgendes System ist anzuwenden: 3

- Im Falle der Voraussetzung a) gemäß Abschnitt 2:
  1999/472/EC, geändert durch 2001/596/EC:
  Folgendes System ist anzuwenden: 4

5 Für die Durchführung des Systems zur Bewertung und Überprüfung der Leistungsbeständigkeit erforderliche technische Einzelheiten gemäß anwendbarem Europäischen Bewertungsdokument

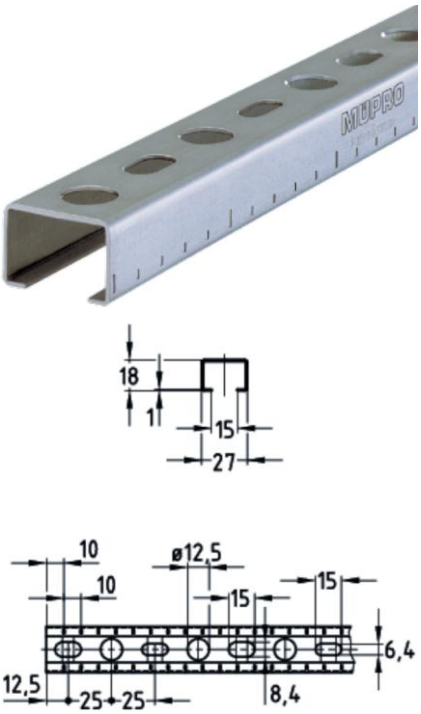
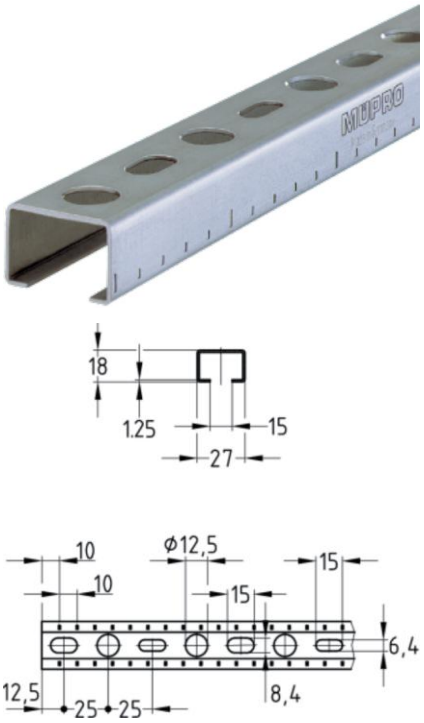
Technische Einzelheiten, die für die Durchführung des Systems zur Bewertung und Überprüfung der Leistungsbeständigkeit notwendig sind, sind Bestandteil des Prüfplans, der beim Centre Scientifique et Technique du Bâtiment hinterlegt ist.

Der Hersteller beauftragt auf vertraglicher Basis eine auf dem Gebiet der Installationsschienen zugelassene notifizierte Stelle mit der Ausstellung der CE-Konformitätsbescheinigung entsprechend dem Kontrollplan.

Die originale französische Version ist unterzeichnet von

Loic PAYET
Head of the Structure, Masonry, Partition Division

Tabelle A1: Abmessungen und Materialien der MÜPRO MPC 27/18 und MPC 27/18L Schienen

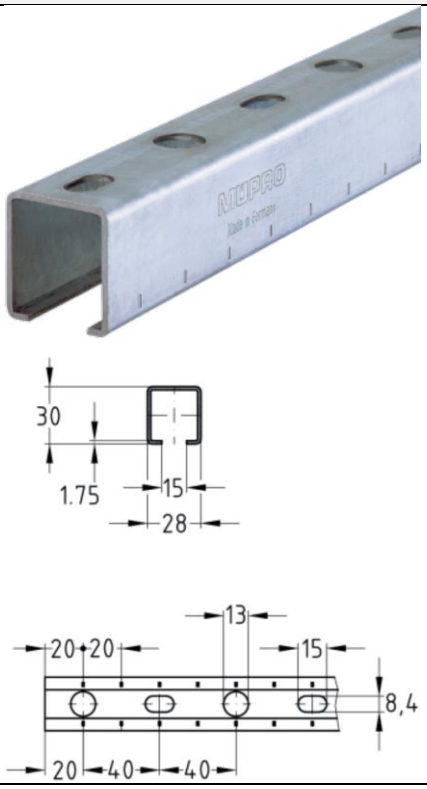
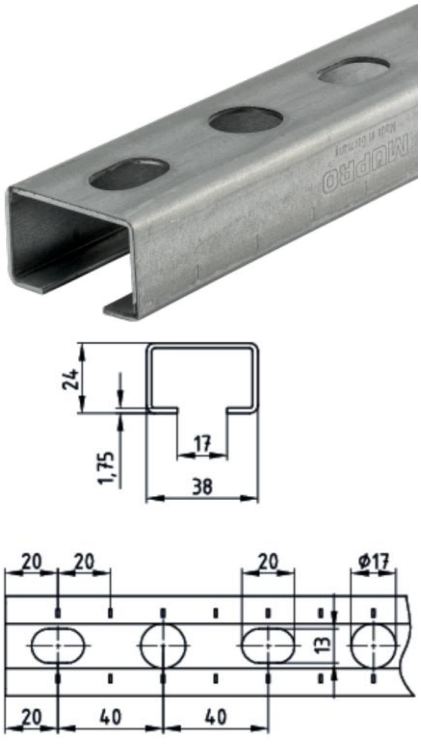
Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPC 27/18L	129876	2000	DX51D + Z275NA (1.0226) Gemäß EN 10142
	MÜPRO Schiene MPC 27/18	129883 129911 105208 130003	1 000 2 000 3 000 6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		129909 130004	2 000 6 000	DD11 (1.0332), Feuerverzinkter Stahl Gemäß EN 10111 DC01 (1.0330), Feuerverzinkter Stahl Gemäß EN 10130
		129907 129999	2 000 6 000	V2A (1.4301) Gemäß EN 10028-7
		129908	2 000	V4A (1.4404) Gemäß EN 10028-7

MÜPRO MPC Schienen

Produktbeschreibung
Form, Abmessungen und Werkstoff

Anhang A1

Tabelle A2: Abmessungen und Materialien der MÜPRO MPC 28/30 und MPC 38/24 Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPC 28/30	118590 118692 118822 118994	2 000 3 040 4 000 6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		118990	6 000	DD11 (1.0332), Feuerverzinkter Stahl Gemäß EN 10111 DC01 (1.0330), Feuerverzinkter Stahl Gemäß EN 10130
		118582 118976	2 000 6 000	V2A (1.4301) Gemäß EN 10028-7
		118586 118979	2 000 6 000	V4A (1.4404) Gemäß EN 10028-7
	MÜPRO Schiene MPC 38/24	139920 153256 139922	2 000 3 040 6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		177003	6 000	V4A (1.4404) Gemäß EN 10028-7

MÜPRO MPC Schienen

Produktbeschreibung
Form, Abmessungen und Werkstoff

Anhang A2

Tabelle A3: Abmessungen und Materialien der MÜPRO MPC 38/40 und MPC 39/52 Schienen

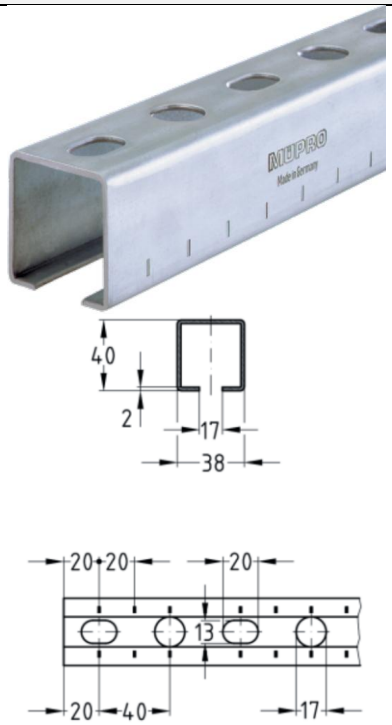
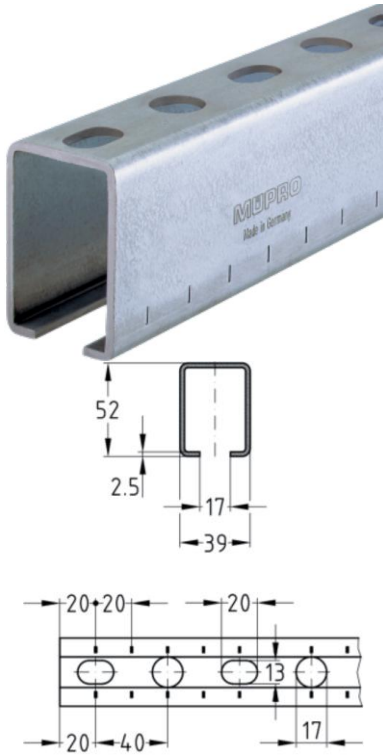
Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPC 38/40	129917 129945 129964 130011	2 000 3 040 4 000 6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		129916 130008	2 000 6 000	DD11 (1.0332), Feuerverzinkter Stahl Gemäß EN 10111 DC01 (1.0330), Feuerverzinkter Stahl Gemäß EN 10130
		129914 129962 130006	2 000 4 000 6 000	V2A (1.4301) Gemäß EN 10028-7
		129915 129963 130007	2 000 4 000 6 000	V4A (1.4404) Gemäß EN 10088-2
	MÜPRO Schiene MPC 39/52	130015	6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		130012	6 000	V2A (1.4301) Gemäß EN 10028-7

Tabelle A4: Abmessungen und Materialien der MÜPRO MPC 40/60 und MPC 40/80 Schienen

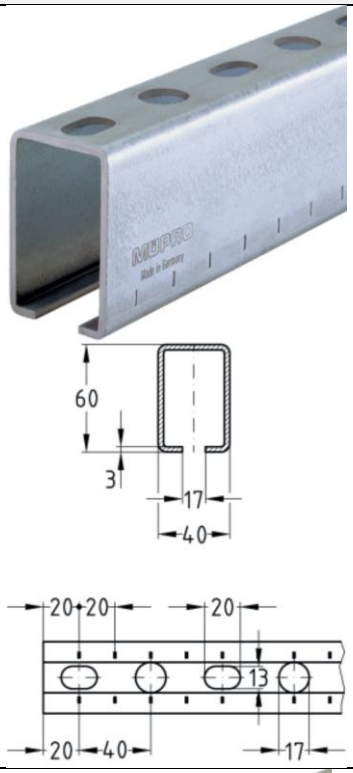
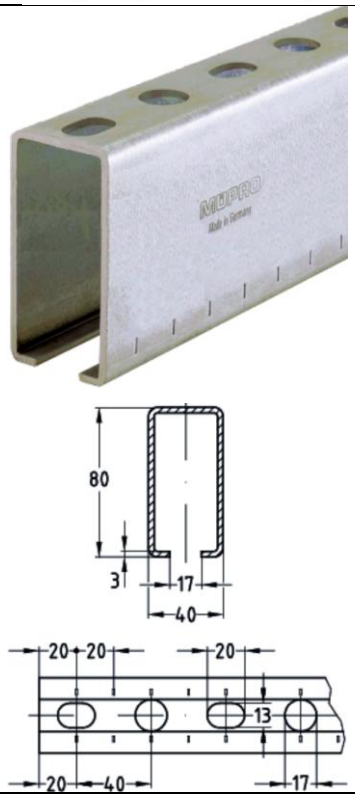
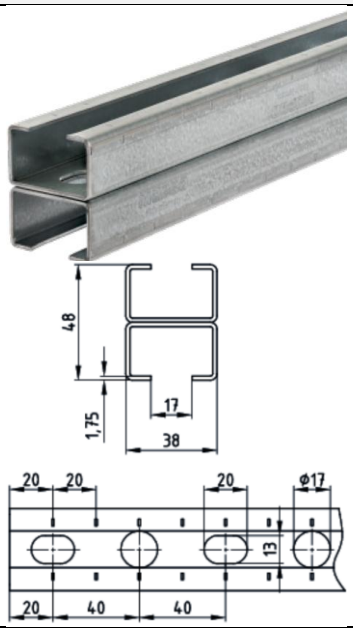
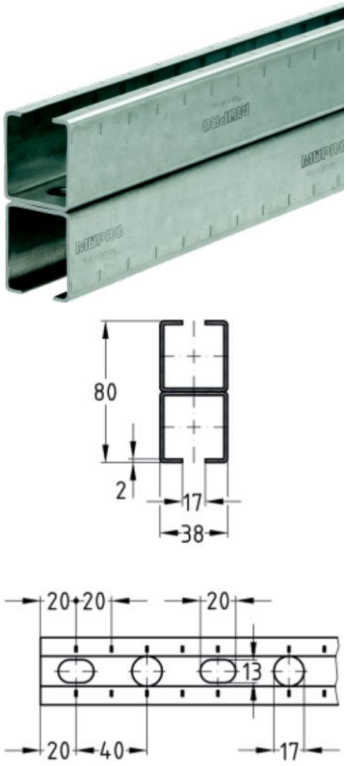
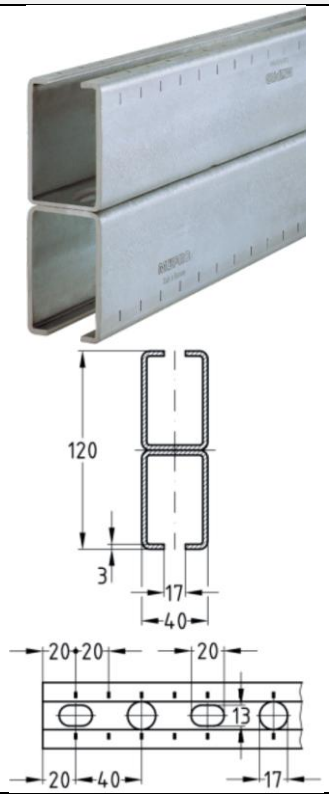
Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPC 40/60	129921 129946 129965 130020	2 000 3 040 4 000 6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		129920 130019	2 000 6 000	DD11 (1.0332), Feuerverzinkter Stahl Gemäß EN 10111 DC01 (1.0330), Feuerverzinkter Stahl Gemäß EN 10130
		130017	6 000	V2A (1.4301) Gemäß EN 10028-7
		130018	6 000	V4A (1.4404) Gemäß EN 10028-7
	MÜPRO Schiene MPC 40/80	130024	6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
		130022	6 000	DD11 (1.0332), Feuerverzinkter Stahl Gemäß EN 10111 DC01 (1.0330), Feuerverzinkter Stahl Gemäß EN 10130
		162963	6 000	V2A (1.4301) Gemäß EN 10028-7

Tabelle A5: Abmessungen und Materialien der MÜPRO MPC 38/48 H und 38/80 H Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPC 38/48 H	141179	6 000	DX51D + Z275NA (1.0226) Gemäß EN 10142
	MÜPRO Schiene MPC 38/80 H	129870 129872 129874	2 000 4 000 6 640	DX51D + Z275NA (1.0226) Gemäß EN 10142

Doppelschienen bestehen aus zwei MPC 38/48 oder 38/80 Einzelschienenprofilen, die auf der Rückseite form- und kraftschlüssig miteinander verbunden sind, beispielsweise durch eine geclinchte oder geschweißte Verbindung.

Tabelle A6: Abmessungen und Materialien der MÜPRO MPC 40/120 H Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPC 40/120 H	129875	6 640	DX51D + Z275NA (1.0226) Gemäß EN 10142
		130033	6 640	DD11 (1.0332), Feuerverzinkter Stahl Gemäß EN 10111 DC01 (1.0330), Feuerverzinkter Stahl Gemäß EN 10130

Doppelschienen bestehen aus zwei MPC 40/120 Einzelschienenprofilen, die auf der Rückseite form- und kraftschlüssig miteinander verbunden sind, beispielsweise durch eine geclinchte oder geschweißte Verbindung.

Voraussetzung für die Leistungsbemessung

- MÜPRO MPC-Schienen werden zur Übertragung von Lasten aus gebäudetechnischen Komponenten wie Rohrleitungen und Anlagen für Wasser-, Heizungs-, Kühl-, Lüftungs-, Elektro- und andere Systeme verwendet. Die MÜPRO MPC-Schienen übernehmen diese tragende Funktion unter den in Abschnitt 2 dieser Europäischen Technischen Bewertung beschriebenen Bedingungen.
- MÜPRO MPC-Schienen (unabhängig von Länge und Beschichtung) im Geltungsbereich dieser Europäischen Technischen Bewertung werden für Anwendungen bei Umgebungstemperatur verwendet.

Tabelle B1: Querschnittseigenschaften der Müpro-Schienen MPC 27/18L, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	55.78	mm^2	
	A_{geom}	55.78	mm^2	geometric (not ideal)
Shear areas	A_y	17.26	mm^2	
	A_z	30.38	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.38	mm	
Moments of inertia	I_y	2380.17	mm^4	about centroidal axes y, z
	I_z	7559.9	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	9940.07	mm^4	
	$I_{p,M}$	27215.07	mm^4	about shear center M
Radii of gyration	i_y	6.53	mm	relative to centroid C
	i_z	11.64	mm	
Polar radii of gyration	i_p	13.35	mm	
	$i_{p,M}$	22.09	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.41	mm	
Cross-section weight	G	0.4	kg/m	
Cross-section perimeter	U	115.46	mm	incl. inner side of cells
Torsional constant	I_t	20.39	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	6928.67	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.98	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	17.6	mm	
Warping constants	$I_{\omega,s}$	2870000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	528388.53	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	276.16	mm^3	in distance 8.6 mm
	$W_{y,min}$	-253.72	mm^3	in distance -9.4 mm
	$W_{z,max}$	570.56	mm^3	in distance 13.3 mm
	$W_{z,min}$	-570.56	mm^3	in distance -13.3 mm
Warping section moduli	$W_{\omega,M,max}$	2258.27	mm^4	in node 12
	$W_{\omega,M,min}$	-2257.59	mm^4	in node 1
Torsional section modulus	W_t	20.39	mm^3	
Stability parameters	r_u	-1.29	mm	
	$r_{m,v}$	-36.48	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B2: Querschnittseigenschaften der Müpro-Schienen MPC 27/18L, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	61.88	mm^2	
	A_{geom}	61.88	mm^2	geometric (not ideal)
Shear areas	A_y	17.42	mm^2	
	A_z	28.89	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.18	mm	
Moments of inertia	I_y	2743.12	mm^4	about centroidal axes y, z
	I_z	7700.81	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	10443.94	mm^4	
	$I_{p,M}$	27545.93	mm^4	about shear center M
Radii of gyration	i_y	6.66	mm	relative to centroid C
	i_z	11.16	mm	
Polar radii of gyration	i_p	12.99	mm	
	$i_{p,M}$	21.1	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.43	mm	
Cross-section weight	G	0.5	kg/m	
Cross-section perimeter	U	127.66	mm	incl. inner side of cells
Torsional constant	I_t	20.39	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	6872.05	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.81	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	16.62	mm	
Warping constants	$I_{\omega,s}$	2670000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	540834.52	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	350.86	mm^3	in distance 7.8 mm
	$W_{y,min}$	-269.42	mm^3	in distance -10.2 mm
	$W_{z,max}$	581.19	mm^3	in distance 13.3 mm
	$W_{z,min}$	-581.19	mm^3	in distance -13.3 mm
Warping section moduli	$W_{\omega,M,max}$	2298.66	mm^4	in node 12
	$W_{\omega,M,min}$	-2298.06	mm^4	in node 1
Torsional section modulus	W_t	20.39	mm^3	
Stability parameters	r_u	-4.17	mm	
	$r_{m,v}$	-37.41	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B3: Querschnittseigenschaften der Müpro-Schienen MPC 27/18L, nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	68.28	mm^2	
	A_{geom}	68.28	mm^2	geometric (not ideal)
Shear areas	A_y	17.45	mm^2	
	A_z	27.13	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.87	mm	
Moments of inertia	I_y	3054.3	mm^4	about centroidal axes y, z
	I_z	7722.66	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	10776.96	mm^4	
	$I_{p,M}$	28065.4	mm^4	about shear center M
Radii of gyration	i_y	6.69	mm	relative to centroid C
	i_z	10.63	mm	
Polar radii of gyration	i_p	12.56	mm	
	$i_{p,M}$	20.27	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.4	mm	
Cross-section weight	G	0.5	kg/m	
Cross-section perimeter	U	138.46	mm	incl. inner side of cells
Torsional constant	I_t	20.6	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	6860.43	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.78	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	15.91	mm	
Warping constants	$I_{\omega,s}$	2499000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	542723.26	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	428.24	mm^3	in distance 7.1 mm
	$W_{y,min}$	-281.04	mm^3	in distance -10.9 mm
	$W_{z,max}$	582.84	mm^3	in distance 13.3 mm
	$W_{z,min}$	-582.84	mm^3	in distance -13.3 mm
Warping section moduli	$W_{\omega,M,max}$	2304.74	mm^4	in node 11
	$W_{\omega,M,min}$	-2304.2	mm^4	in node 1
Torsional section modulus	W_t	20.6	mm^3	
Stability parameters	r_u	-6.67	mm	
	$r_{m,v}$	-38.49	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B4: Querschnittseigenschaften der Müpro-Schienen MPC 27/18L, durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	64.03	mm^2	
	A_{geom}	64.03	mm^2	geometric (not ideal)
Shear areas	A_y	14.41	mm^2	
	A_z	28.0	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.43	mm	
Moments of inertia	I_y	2854.2	mm^4	about centroidal axes y, z
	I_z	7667.32	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	10521.52	mm^4	
	$I_{p,M}$	27783.82	mm^4	about shear center M
Radii of gyration	i_y	6.68	mm	relative to centroid C
	i_z	10.94	mm	
Polar radii of gyration	i_p	12.82	mm	
	$i_{p,M}$	20.83	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.4	mm	
Cross-section weight	G	0.5	kg/m	
Cross-section perimeter	U	139.14	mm	incl. inner side of cells
Torsional constant	I_t	17.63	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	6884.51	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.85	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	16.42	mm	
Warping constants	$I_{\omega,s}$	2606000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	537917.76	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	376.91	mm^3	in distance 7.6 mm
	$W_{y,min}$	-273.72	mm^3	in distance -10.4 mm
	$W_{z,max}$	578.67	mm^3	in distance 13.3 mm
	$W_{z,min}$	-578.67	mm^3	in distance -13.3 mm
Warping section moduli	$W_{\omega,M,max}$	2289.23	mm^4	in node 12
	$W_{\omega,M,min}$	-2288.64	mm^4	in node 1
Torsional section modulus	W_t	17.63	mm^3	
Stability parameters	r_u	-5.19	mm	
	$r_{m,v}$	-38.03	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B5: Querschnittseigenschaften der Müpro-Schienen MPC 27/18, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	69.19	mm^2	
	A_{geom}	69.19	mm^2	geometric (not ideal)
Shear areas	A_y	21.94	mm^2	
	A_z	37.33	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.38	mm	
Moments of inertia	I_y	2877.41	mm^4	about centroidal axes y, z
	I_z	9484.61	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	12362.03	mm^4	
	$I_{p,M}$	33244.6	mm^4	about shear center M
Radii of gyration	i_y	6.45	mm	relative to centroid C
	i_z	11.71	mm	
Polar radii of gyration	i_p	13.37	mm	
	$i_{p,M}$	21.92	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.45	mm	
Cross-section weight	G	0.5	kg/m	
Cross-section perimeter	U	115.57	mm	incl. inner side of cells
Torsional constant	I_t	38.39	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	8714.89	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.75	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	17.37	mm	
Warping constants	$I_{\omega,s}$	3522000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	658242.64	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	333.74	mm^3	in distance 8.6 mm
	$W_{y,min}$	-306.81	mm^3	in distance -9.4 mm
	$W_{z,max}$	702.56	mm^3	in distance 13.5 mm
	$W_{z,min}$	-702.56	mm^3	in distance -13.5 mm
Warping section moduli	$W_{\omega,M,max}$	2812.74	mm^4	in node 14
	$W_{\omega,M,min}$	-2813.97	mm^4	in node 1
Torsional section modulus	W_t	30.71	mm^3	
Stability parameters	r_u	-1.31	mm	
	$r_{m,v}$	-36.06	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B6: Querschnittseigenschaften der Müpro-Schienen MPC 27/18, Lochbereich, Langloch 1

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	74.32	mm^2	
	A_{geom}	74.32	mm^2	geometric (not ideal)
Shear areas	A_y	22.1	mm^2	
	A_z	36.13	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.93	mm	
Moments of inertia	I_y	3183.19	mm^4	about centroidal axes y, z
	I_z	9626.32	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	12809.52	mm^4	
	$I_{p,M}$	33494.05	mm^4	about shear center M
Radii of gyration	i_y	6.54	mm	relative to centroid C
	i_z	11.38	mm	
Polar radii of gyration	i_p	13.13	mm	
	$i_{p,M}$	21.23	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.47	mm	
Cross-section weight	G	0.6	kg/m	
Cross-section perimeter	U	123.77	mm	incl. inner side of cells
Torsional constant	I_t	38.38	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	8661.77	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.61	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	16.68	mm	
Warping constants	$I_{\omega,s}$	3351000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	670541.84	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	394.45	mm^3	in distance 8.1 mm
	$W_{y,min}$	-320.56	mm^3	in distance -9.9 mm
	$W_{z,max}$	713.06	mm^3	in distance 13.5 mm
	$W_{z,min}$	-713.06	mm^3	in distance -13.5 mm
Warping section moduli	$W_{\omega,M,max}$	2852.74	mm^4	in node 14
	$W_{\omega,M,min}$	-2853.91	mm^4	in node 1
Torsional section modulus	W_t	30.71	mm^3	
Stability parameters	r_u	-3.33	mm	
	$r_{m,v}$	-36.7	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B7: Querschnittseigenschaften der Müpro-Schienen MPC 27/18, Lochbereich, Langloch 2

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	76.82	mm^2	
	A_{geom}	76.82	mm^2	geometric (not ideal)
Shear areas	A_y	22.14	mm^2	
	A_z	35.47	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.17	mm	
Moments of inertia	I_y	3317.57	mm^4	about centroidal axes y, z
	I_z	9660.76	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	12978.33	mm^4	
	$I_{p,M}$	33659.2	mm^4	about shear center M
Radii of gyration	i_y	6.57	mm	relative to centroid C
	i_z	11.21	mm	
Polar radii of gyration	i_p	13.0	mm	
	$i_{p,M}$	20.93	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.47	mm	
Cross-section weight	G	0.6	kg/m	
Cross-section perimeter	U	127.77	mm	incl. inner side of cells
Torsional constant	I_t	38.38	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	8645.5	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.58	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	16.41	mm	
Warping constants	$I_{\omega,s}$	3276000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	673475.81	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	423.83	mm^3	in distance 7.8 mm
	$W_{y,min}$	-326.13	mm^3	in distance -10.2 mm
	$W_{z,max}$	715.61	mm^3	in distance 13.5 mm
	$W_{z,min}$	-715.61	mm^3	in distance -13.5 mm
Warping section moduli	$W_{\omega,M,max}$	2862.24	mm^4	in node 14
	$W_{\omega,M,min}$	-2863.38	mm^4	in node 1
Torsional section modulus	W_t	30.71	mm^3	
Stability parameters	r_u	-4.24	mm	
	$r_{m,v}$	-37.06	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B8: Querschnittseigenschaften der Müpro-Schienen MPC 27/18, nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	84.82	mm^2	
	A_{geom}	84.82	mm^2	geometric (not ideal)
Shear areas	A_y	22.17	mm^2	
	A_z	33.29	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.85	mm	
Moments of inertia	I_y	3694.47	mm^4	about centroidal axes y, z
	I_z	9688.06	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	13382.54	mm^4	
	$I_{p,M}$	34296.66	mm^4	about shear center M
Radii of gyration	i_y	6.6	mm	relative to centroid C
	i_z	10.69	mm	
Polar radii of gyration	i_p	12.56	mm	
	$i_{p,M}$	20.11	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.44	mm	
Cross-section weight	G	0.7	kg/m	
Cross-section perimeter	U	138.07	mm	incl. inner side of cells
Torsional constant	I_t	38.9	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	8631.46	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.55	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	15.7	mm	
Warping constants	$I_{\omega,s}$	3066000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	675787.65	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	516.86	mm^3	in distance 7.1 mm
	$W_{y,min}$	-340.44	mm^3	in distance -10.9 mm
	$W_{z,max}$	717.63	mm^3	in distance 13.5 mm
	$W_{z,min}$	-717.63	mm^3	in distance -13.5 mm
Warping section moduli	$W_{\omega,M,max}$	2869.78	mm^4	in node 14
	$W_{\omega,M,min}$	-2870.81	mm^4	in node 1
Torsional section modulus	W_t	31.12	mm^3	
Stability parameters	r_u	-6.77	mm	
	$r_{m,v}$	-38.17	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B9: Querschnittseigenschaften der Müpro-Schienen MPC 27/18, durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	79.27	mm^2	
	A_{geom}	79.27	mm^2	geometric (not ideal)
Shear areas	A_y	18.09	mm^2	
	A_z	34.41	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.4	mm	
Moments of inertia	I_y	3440.59	mm^4	about centroidal axes y, z
	I_z	9615.88	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	13056.47	mm^4	
	$I_{p,M}$	33932.5	mm^4	about shear center M
Radii of gyration	i_y	6.59	mm	relative to centroid C
	i_z	11.01	mm	
Polar radii of gyration	i_p	12.83	mm	
	$i_{p,M}$	20.69	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.44	mm	
Cross-section weight	G	0.6	kg/m	
Cross-section perimeter	U	138.96	mm	incl. inner side of cells
Torsional constant	I_t	32.95	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	8661.25	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	17.62	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	16.23	mm	
Warping constants	$I_{\omega,s}$	3203000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	669647.55	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	452.45	mm^3	in distance 7.6 mm
	$W_{y,min}$	-330.96	mm^3	in distance -10.4 mm
	$W_{z,max}$	712.29	mm^3	in distance 13.5 mm
	$W_{z,min}$	-712.29	mm^3	in distance -13.5 mm
Warping section moduli	$W_{\omega,M,max}$	2849.91	mm^4	in node 14
	$W_{\omega,M,min}$	-2851.0	mm^4	in node 1
Torsional section modulus	W_t	26.36	mm^3	
Stability parameters	r_u	-5.21	mm	
	$r_{m,v}$	-37.66	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B10: Querschnittseigenschaften der Müpro-Schienen MPC 28/30, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	136.117	mm^2	
	A_{geom}	136.117	mm^2	geometric (not ideal)
Shear areas	A_y	26.868	mm^2	
	A_z	91.291	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.363	mm	
Moments of inertia	I_y	13935.582	mm^4	about centroidal axes y, z
	I_z	20492.514	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	34428.096	mm^4	
	$I_{p,M}$	149480.0	mm^4	about shear center M
Radii of gyration	i_y	10.118	mm	relative to centroid C
	i_z	12.27	mm	
Polar radii of gyration	i_p	15.904	mm	
	$i_{p,M}$	33.139	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.665	mm	
Cross-section weight	G	1.1	kg/m	
Cross-section perimeter	U	162.554	mm	incl. inner side of cells
Torsional constant	I_t	138.844	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	21597.558	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	29.436	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	29.073	mm	
Warping constants	$I_{\omega,s}$	20595000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	3253600.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	952.102	mm^3	in distance 14.637 mm
	$W_{y,min}$	-907.066	mm^3	in distance -15.363 mm
	$W_{z,max}$	1463.751	mm^3	in distance 14 mm
	$W_{z,min}$	-1463.751	mm^3	in distance -14 mm
Warping section moduli	$W_{\omega,M,max}$	7900.539	mm^4	in node 1
	$W_{\omega,M,min}$	-7904.66	mm^4	in node 6
Torsional section modulus	W_t	79.339	mm^3	
Stability parameters	r_u	-0.741	mm	
	$r_{m,v}$	-58.888	mm	
Reduction factor	λ_M	0.004	1/mm	

Tabelle B11: Querschnittseigenschaften der Müpro-Schienen MPC 28/30, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	144.167	mm^2	
	A_{geom}	144.167	mm^2	geometric (not ideal)
Shear areas	A_y	27.097	mm^2	
	A_z	90.02	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.132	mm	
Moments of inertia	I_y	15377.006	mm^4	about centroidal axes y, z
	I_z	20726.474	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	36103.48	mm^4	
	$I_{p,M}$	150200.0	mm^4	about shear center M
Radii of gyration	i_y	10.328	mm	relative to centroid C
	i_z	11.99	mm	
Polar radii of gyration	i_p	15.825	mm	
	$i_{p,M}$	32.278	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.693	mm	
Cross-section weight	G	1.1	kg/m	
Cross-section perimeter	U	171.754	mm	incl. inner side of cells
Torsional constant	I_t	138.841	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	21531.441	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	29.265	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	28.132	mm	
Warping constants	$I_{\omega,s}$	19731000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	3308000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	1108.82	mm^3	in distance 13.868 mm
	$W_{y,min}$	-953.193	mm^3	in distance -16.132 mm
	$W_{z,max}$	1480.462	mm^3	in distance 14 mm
	$W_{z,min}$	-1480.462	mm^3	in distance -14 mm
Warping section moduli	$W_{\omega,M,max}$	8007.846	mm^4	in node 1
	$W_{\omega,M,min}$	-8011.808	mm^4	in node 6
Torsional section modulus	W_t	79.338	mm^3	
Stability parameters	r_u	-2.442	mm	
	$r_{m,v}$	-58.707	mm	
Reduction factor	λ_M	0.004	1/mm	

Tabelle B12: Querschnittseigenschaften der Müpro-Schienen MPC 28/30, nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	158.867	mm^2	
	A_{geom}	158.867	mm^2	geometric (not ideal)
Shear areas	A_y	27.179	mm^2	
	A_z	86.152	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	2.335	mm	
Moments of inertia	I_y	17632.639	mm^4	about centroidal axes y, z
	I_z	20812.91	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	38445.549	mm^4	
	$I_{p,M}$	153130.0	mm^4	about shear center M
Radii of gyration	i_y	10.535	mm	relative to centroid C
	i_z	11.446	mm	
Polar radii of gyration	i_p	15.556	mm	
	$i_{p,M}$	31.047	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.662	mm	
Cross-section weight	G	1.2	kg/m	
Cross-section perimeter	U	185.054	mm	incl. inner side of cells
Torsional constant	I_t	140.81	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	21502.372	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	29.203	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	26.868	mm	
Warping constants	$I_{\omega,s}$	18370000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	3327900.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	1392.209	mm^3	in distance 12.665 mm
	$W_{y,min}$	-1017.183	mm^3	in distance -17.335 mm
	$W_{z,max}$	1486.636	mm^3	in distance 14 mm
	$W_{z,min}$	-1486.636	mm^3	in distance -14 mm
Warping section moduli	$W_{\omega,M,max}$	8047.01	mm^4	in node 1
	$W_{\omega,M,min}$	-8050.629	mm^4	in node 6
Torsional section modulus	W_t	80.463	mm^3	
Stability parameters	r_u	-5.276	mm	
	$r_{m,v}$	-59.012	mm	
Reduction factor	λ_M	0.004	1/mm	

Tabelle B13: Querschnittseigenschaften der Müpro-Schienen MPC 28/30, durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	153.537	mm^2	
	A_{geom}	153.537	mm^2	geometric (not ideal)
Shear areas	A_y	24.593	mm^2	
	A_z	87.264	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.925	mm	
Moments of inertia	I_y	16862.79	mm^4	about centroidal axes y, z
	I_z	20737.846	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	37600.635	mm^4	
	$I_{p,M}$	152300.0	mm^4	about shear center M
Radii of gyration	i_y	10.48	mm	relative to centroid C
	i_z	11.622	mm	
Polar radii of gyration	i_p	15.649	mm	
	$i_{p,M}$	31.495	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	4.662	mm	
Cross-section weight	G	1.2	kg/m	
Cross-section perimeter	U	185.874	mm	incl. inner side of cells
Torsional constant	I_t	128.013	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	21524.079	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	29.257	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	27.332	mm	
Warping constants	$I_{\omega,s}$	18821000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	3310700.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	1289.729	mm^3	in distance 19.97 mm
	$W_{y,min}$	-996.305	mm^3	in distance -21.03 mm
	$W_{z,max}$	1481.275	mm^3	in distance 20.5 mm
	$W_{z,min}$	-1481.275	mm^3	in distance -20.5 mm
Warping section moduli	$W_{\omega,M,max}$	8013.226	mm^4	in node 38
	$W_{\omega,M,min}$	-8016.948	mm^4	in node 26
Torsional section modulus	W_t	73.15	mm^3	
Stability parameters	r_u	-4.356	mm	
	$r_{m,v}$	-59.02	mm	
Reduction factor	λ_M	0.004	1/mm	

Tabelle B14: Querschnittseigenschaften der Müpro-Schienen MPC 38/24, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	139.62	mm^2	
	A_{geom}	139.62	mm^2	geometric (not ideal)
Shear areas	A_y	42.03	mm^2	
	A_z	67.74	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.0	mm	
Moments of inertia	I_y	10823.57	mm^4	about centroidal axes y, z
	I_z	36127.2	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	46950.76	mm^4	
	$I_{p,M}$	130757.77	mm^4	about shear center M
Radii of gyration	i_y	8.8	mm	relative to centroid C
	i_z	16.09	mm	
Polar radii of gyration	i_p	18.34	mm	
	$i_{p,M}$	30.6	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.8	mm	
Cross-section weight	G	1.1	kg/m	
Cross-section perimeter	U	166.55	mm	incl. inner side of cells
Torsional constant	I_t	149.55	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	34452.42	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	24.5	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	24.5	mm	
Warping constants	$I_{\omega,s}$	27740000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	6041000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	901.96	mm^3	in distance 12 mm
	$W_{y,min}$	-901.96	mm^3	in distance -12 mm
	$W_{z,max}$	1901.43	mm^3	in distance 19 mm
	$W_{z,min}$	-1901.43	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	12064.7	mm^4	in node 14
	$W_{\omega,M,min}$	-12069.26	mm^4	in node 1
Torsional section modulus	W_t	85.46	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B15: Querschnittseigenschaften der Müpro-Schienen MPC 38/24, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	146.62	mm^2	
	A_{geom}	146.62	mm^2	geometric (not ideal)
Shear areas	A_y	42.27	mm^2	
	A_z	66.38	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.53	mm	
Moments of inertia	I_y	11650.33	mm^4	about centroidal axes y, z
	I_z	36523.28	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	48173.61	mm^4	
	$I_{p,M}$	131391.96	mm^4	about shear center M
Radii of gyration	i_y	8.91	mm	relative to centroid C
	i_z	15.78	mm	
Polar radii of gyration	i_p	18.13	mm	
	$i_{p,M}$	29.94	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.82	mm	
Cross-section weight	G	1.2	kg/m	
Cross-section perimeter	U	174.55	mm	incl. inner side of cells
Torsional constant	I_t	149.55	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	34348.15	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	24.36	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	23.82	mm	
Warping constants	$I_{\omega,s}$	26850000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	6111000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	1015.84	mm^3	in distance 11.5 mm
	$W_{y,min}$	-929.69	mm^3	in distance -12.5 mm
	$W_{z,max}$	1922.28	mm^3	in distance 19 mm
	$W_{z,min}$	-1922.28	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	12175.12	mm^4	in node 14
	$W_{\omega,M,min}$	-12179.54	mm^4	in node 1
Torsional section modulus	W_t	85.46	mm^3	
Stability parameters	r_u	-2.05	mm	
	$r_{m,v}$	-49.7	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B16: Querschnittseigenschaften der Müpro-Schienen MPC 38/24, nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	169.37	mm^2	
	A_{geom}	169.37	mm^2	geometric (not ideal)
Shear areas	A_y	42.45	mm^2	
	A_z	61.01	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.95	mm	
Moments of inertia	I_y	13866.2	mm^4	about centroidal axes y, z
	I_z	36843.68	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	50709.87	mm^4	
	$I_{p,M}$	134831.42	mm^4	about shear center M
Radii of gyration	i_y	9.05	mm	relative to centroid C
	i_z	14.75	mm	
Polar radii of gyration	i_p	17.3	mm	
	$i_{p,M}$	28.22	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.76	mm	
Cross-section weight	G	1.3	kg/m	
Cross-section perimeter	U	197.05	mm	incl. inner side of cells
Torsional constant	I_t	151.52	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	34237.73	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	24.24	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	22.29	mm	
Warping constants	$I_{\omega,s}$	24480000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	6167000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	1380.38	mm^3	in distance 10.05 mm
	$W_{y,min}$	-993.65	mm^3	in distance -13.95 mm
	$W_{z,max}$	1939.14	mm^3	in distance 19 mm
	$W_{z,min}$	-1939.14	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	12262.64	mm^4	in node 14
	$W_{\omega,M,min}$	-12266.52	mm^4	in node 1
Torsional section modulus	W_t	86.58	mm^3	
Stability parameters	r_u	-7.61	mm	
	$r_{m,v}$	-52.18	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B17: Querschnittseigenschaften der Müpro-Schienen MPC 38/24, durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	159.51	mm^2	
	A_{geom}	159.51	mm^2	geometric (not ideal)
Shear areas	A_y	35.44	mm^2	
	A_z	62.79	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.39	mm	
Moments of inertia	I_y	12980.45	mm^4	about centroidal axes y, z
	I_z	36606.22	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	49586.67	mm^4	
	$I_{p,M}$	133513.17	mm^4	about shear center M
Radii of gyration	i_y	9.02	mm	relative to centroid C
	i_z	15.15	mm	
Polar radii of gyration	i_p	17.63	mm	
	$i_{p,M}$	28.93	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.77	mm	
Cross-section weight	G	1.25	kg/m	
Cross-section perimeter	U	198.21	mm	incl. inner side of cells
Torsional constant	I_t	130.23	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	34203.63	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	24.33	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	22.94	mm	
Warping constants	$I_{\omega,s}$	25400000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	6126000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	1223.16	mm^3	in distance 10.61 mm
	$W_{y,min}$	-969.58	mm^3	in distance -13.39 mm
	$W_{z,max}$	1926.64	mm^3	in distance 19 mm
	$W_{z,min}$	-1926.64	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	12198.11	mm^4	in node 14
	$W_{\omega,M,min}$	-12202.18	mm^4	in node 1
Torsional section modulus	W_t	74.42	mm^3	
Stability parameters	r_u	-5.58	mm	
	$r_{m,v}$	-51.46	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B18: Querschnittseigenschaften der Müpro-Schienen MPC 38/40, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	221.13	mm^2	
	A_{geom}	221.13	mm^2	geometric (not ideal)
Shear areas	A_y	41.12	mm^2	
	A_z	139.78	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.0	mm	
Moments of inertia	I_y	43156.38	mm^4	about centroidal axes y, z
	I_z	60878.91	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	104035.29	mm^4	
	$I_{p,M}$	467065.44	mm^4	about shear center M
Radii of gyration	i_y	13.97	mm	relative to centroid C
	i_z	16.59	mm	
Polar radii of gyration	i_p	21.69	mm	
	$i_{p,M}$	45.96	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.9	mm	
Cross-section weight	G	1.7	kg/m	
Cross-section perimeter	U	229.12	mm	incl. inner side of cells
Torsional constant	I_t	302.23	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	68727.85	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	40.52	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	40.52	mm	
Warping constants	$I_{\omega,s}$	122300000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	22270000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2157.82	mm^3	in distance 20 mm
	$W_{y,min}$	-2157.82	mm^3	in distance -20 mm
	$W_{z,max}$	3204.15	mm^3	in distance 19 mm
	$W_{z,min}$	-3204.15	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	25932.15	mm^4	in node 14
	$W_{\omega,M,min}$	-25940.23	mm^4	in node 1
Torsional section modulus	W_t	151.11	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B19: Querschnittseigenschaften der Müpro-Schienen MPC 38/40, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	229.13	mm^2	
	A_{geom}	229.13	mm^2	geometric (not ideal)
Shear areas	A_y	41.35	mm^2	
	A_z	138.72	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.66	mm	
Moments of inertia	I_y	45946.18	mm^4	about centroidal axes y, z
	I_z	61331.58	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	107277.76	mm^4	
	$I_{p,M}$	468336.01	mm^4	about shear center M
Radii of gyration	i_y	14.16	mm	relative to centroid C
	i_z	16.36	mm	
Polar radii of gyration	i_p	21.64	mm	
	$i_{p,M}$	45.21	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.93	mm	
Cross-section weight	G	1.8	kg/m	
Cross-section perimeter	U	237.12	mm	incl. inner side of cells
Torsional constant	I_t	302.23	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	68590.24	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	40.36	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	39.7	mm	
Warping constants	$I_{\omega,s}$	119200000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	22480000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2376.15	mm^3	in distance 19.34 mm
	$W_{y,min}$	-2223.53	mm^3	in distance -20.66 mm
	$W_{z,max}$	3227.98	mm^3	in distance 19 mm
	$W_{z,min}$	-3227.98	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	26134.35	mm^4	in node 14
	$W_{\omega,M,min}$	-26142.24	mm^4	in node 1
Torsional section modulus	W_t	151.11	mm^3	
Stability parameters	r_u	-1.49	mm	
	$r_{m,v}$	-80.89	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B20: Querschnittseigenschaften der Müpro-Schienen MPC 38/40, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	255.13	mm^2	
	A_{geom}	255.13	mm^2	geometric (not ideal)
Shear areas	A_y	41.54	mm^2	
	A_z	132.64	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	2.53	mm	
Moments of inertia	I_y	53805.57	mm^4	about centroidal axes y, z
	I_z	61697.74	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	115503.31	mm^4	
	$I_{p,M}$	478148.49	mm^4	about shear center M
Radii of gyration	i_y	14.52	mm	relative to centroid C
	i_z	15.55	mm	
Polar radii of gyration	i_p	21.28	mm	
	$i_{p,M}$	43.29	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.88	mm	
Cross-section weight	G	2.0	kg/m	
Cross-section perimeter	U	259.12	mm	incl. inner side of cells
Torsional constant	I_t	305.59	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	68461.13	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	40.23	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	37.7	mm	
Warping constants	$I_{\omega,s}$	110400000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	22640000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	3080.36	mm^3	in distance 17.47 mm
	$W_{y,min}$	-2387.89	mm^3	in distance -22.53 mm
	$W_{z,max}$	3247.25	mm^3	in distance 19 mm
	$W_{z,min}$	-3247.25	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	26295.85	mm^4	in node 14
	$W_{\omega,M,min}$	-26303.0	mm^4	in node 1
Torsional section modulus	W_t	152.79	mm^3	
Stability parameters	r_u	-5.95	mm	
	$r_{m,v}$	-81.35	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B21: Querschnittseigenschaften der Müpro-Schienen MPC 38/40, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	243.86	mm^2	
	A_{geom}	243.86	mm^2	geometric (not ideal)
Shear areas	A_y	35.79	mm^2	
	A_z	134.94	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.77	mm	
Moments of inertia	I_y	50599.95	mm^4	about centroidal axes y, z
	I_z	61426.3	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	112026.25	mm^4	
	$I_{p,M}$	474542.13	mm^4	about shear center M
Radii of gyration	i_y	14.4	mm	relative to centroid C
	i_z	15.87	mm	
Polar radii of gyration	i_p	21.43	mm	
	$i_{p,M}$	44.11	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.89	mm	
Cross-section weight	G	1.91	kg/m	
Cross-section perimeter	U	260.45	mm	incl. inner side of cells
Torsional constant	I_t	273.8	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	68427.52	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	40.33	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	38.56	mm	
Warping constants	$I_{\omega,s}$	113900000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	22520000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2775.86	mm^3	in distance 18.23 mm
	$W_{y,min}$	-2324.15	mm^3	in distance -21.77 mm
	$W_{z,max}$	3232.96	mm^3	in distance 19 mm
	$W_{z,min}$	-3232.96	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	26176.61	mm^4	in node 14
	$W_{\omega,M,min}$	-26184.04	mm^4	in node 1
Torsional section modulus	W_t	136.9	mm^3	
Stability parameters	r_u	-4.2	mm	
	$r_{m,v}$	-81.31	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B22: Querschnittseigenschaften der Müpro-Schienen MPC 39/52, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	331.05	mm^2	
	A_{geom}	331.05	mm^2	geometric (not ideal)
Shear areas	A_y	47.53	mm^2	
	A_z	228.92	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.0	mm	
Moments of inertia	I_y	101291.36	mm^4	about centroidal axes y, z
	I_z	95797.71	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	197089.07	mm^4	
	$I_{p,M}$	1096000.0	mm^4	about shear center M
Radii of gyration	i_y	17.49	mm	relative to centroid C
	i_z	17.01	mm	
Polar radii of gyration	i_p	24.4	mm	
	$i_{p,M}$	57.55	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.93	mm	
Cross-section weight	G	2.6	kg/m	
Cross-section perimeter	U	274.83	mm	incl. inner side of cells
Torsional constant	I_t	667.71	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114676.19	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	52.12	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	52.12	mm	
Warping constants	$I_{\omega,s}$	313100000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	52590000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	3895.82	mm^3	in distance 26 mm
	$W_{y,min}$	-3895.82	mm^3	in distance -26 mm
	$W_{z,max}$	4912.7	mm^3	in distance 19.5 mm
	$W_{z,min}$	-4912.7	mm^3	in distance -19.5 mm
Warping section moduli	$W_{\omega,M,max}$	45961.43	mm^4	in node 14
	$W_{\omega,M,min}$	-45984.22	mm^4	in node 1
Torsional section modulus	W_t	267.09	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B23: Querschnittseigenschaften der Müpro-Schienen MPC 39/52, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	341.05	mm^2	
	A_{geom}	341.05	mm^2	geometric (not ideal)
Shear areas	A_y	47.78	mm^2	
	A_z	228.34	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.73	mm	
Moments of inertia	I_y	107242.51	mm^4	about centroidal axes y, z
	I_z	96363.54	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	203606.05	mm^4	
	$I_{p,M}$	1099000.0	mm^4	about shear center M
Radii of gyration	i_y	17.73	mm	relative to centroid C
	i_z	16.81	mm	
Polar radii of gyration	i_p	24.43	mm	
	$i_{p,M}$	56.76	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.95	mm	
Cross-section weight	G	2.7	kg/m	
Cross-section perimeter	U	282.83	mm	incl. inner side of cells
Torsional constant	I_t	667.7	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114518.73	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	51.96	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	51.23	mm	
Warping constants	$I_{\omega,s}$	306300000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	53010000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	4243.2	mm^3	in distance 25.27 mm
	$W_{y,min}$	-4012.66	mm^3	in distance -26.73 mm
	$W_{z,max}$	4941.72	mm^3	in distance 19.5 mm
	$W_{z,min}$	-4941.72	mm^3	in distance -19.5 mm
Warping section moduli	$W_{\omega,M,max}$	46276.84	mm^4	in node 14
	$W_{\omega,M,min}$	-46299.16	mm^4	in node 1
Torsional section modulus	W_t	267.08	mm^3	
Stability parameters	r_u	-1.29	mm	
	$r_{m,v}$	-103.75	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B24: Querschnittseigenschaften der Müpro-Schienen MPC 39/52, nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	373.55	mm^2	
	A_{geom}	373.55	mm^2	geometric (not ideal)
Shear areas	A_y	47.98	mm^2	
	A_z	222.1	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	2.82	mm	
Moments of inertia	I_y	124384.29	mm^4	about centroidal axes y, z
	I_z	96821.25	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	221205.54	mm^4	
	$I_{p,M}$	1119000.0	mm^4	about shear center M
Radii of gyration	i_y	18.25	mm	relative to centroid C
	i_z	16.1	mm	
Polar radii of gyration	i_p	24.33	mm	
	$i_{p,M}$	54.72	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.91	mm	
Cross-section weight	G	2.9	kg/m	
Cross-section perimeter	U	303.83	mm	incl. inner side of cells
Torsional constant	I_t	675.9	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114386.93	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	51.83	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	49.01	mm	
Warping constants	$I_{\omega,s}$	286300000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	53350000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	5365.32	mm^3	in distance 23.18 mm
	$W_{y,min}$	-4316.35	mm^3	in distance -28.82 mm
	$W_{z,max}$	4965.19	mm^3	in distance 19.5 mm
	$W_{z,min}$	-4965.19	mm^3	in distance -19.5 mm
Warping section moduli	$W_{\omega,M,max}$	46530.09	mm^4	in node 14
	$W_{\omega,M,min}$	-46550.62	mm^4	in node 1
Torsional section modulus	W_t	270.36	mm^3	
Stability parameters	r_u	-5.32	mm	
	$r_{m,v}$	-103.35	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B25: Querschnittseigenschaften der Müpro-Schienen MPC 39/52, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	359.46	mm^2	
	A_{geom}	359.46	mm^2	geometric (not ideal)
Shear areas	A_y	42.04	mm^2	
	A_z	224.64	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	1.96	mm	
Moments of inertia	I_y	117323.32	mm^4	about centroidal axes y, z
	I_z	96481.85	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	213805.16	mm^4	
	$I_{p,M}$	1111000.0	mm^4	about shear center M
Radii of gyration	i_y	18.07	mm	relative to centroid C
	i_z	16.38	mm	
Polar radii of gyration	i_p	24.39	mm	
	$i_{p,M}$	55.6	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.91	mm	
Cross-section weight	G	2.8	kg/m	
Cross-section perimeter	U	305.49	mm	incl. inner side of cells
Torsional constant	I_t	613.8	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114312.67	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	51.93	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	49.97	mm	
Warping constants	$I_{\omega,s}$	294300000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	53100000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	4879.67	mm^3	in distance 24.04 mm
	$W_{y,min}$	-4196.61	mm^3	in distance -27.96 mm
	$W_{z,max}$	4947.79	mm^3	in distance 19.5 mm
	$W_{z,min}$	-4947.79	mm^3	in distance -19.5 mm
Warping section moduli	$W_{\omega,M,max}$	46343.19	mm^4	in node 14
	$W_{\omega,M,min}$	-46364.41	mm^4	in node 1
Torsional section modulus	W_t	245.52	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B26: Querschnittseigenschaften der Müpro-Schienen MPC 40/60, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	443.97	mm^2	
	A_{geom}	443.97	mm^2	geometric (not ideal)
Shear areas	A_y	54.64	mm^2	
	A_z	316.41	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.0	mm	
Moments of inertia	I_y	174739.85	mm^4	about centroidal axes y, z
	I_z	133540.45	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	308280.29	mm^4	
	$I_{p,M}$	1890000.0	mm^4	about shear center M
Radii of gyration	i_y	19.84	mm	relative to centroid C
	i_z	17.34	mm	
Polar radii of gyration	i_p	26.35	mm	
	$i_{p,M}$	65.25	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.98	mm	
Cross-section weight	G	3.5	kg/m	
Cross-section perimeter	U	307.97	mm	incl. inner side of cells
Torsional constant	I_t	1271.41	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	161583.34	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	59.69	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	59.69	mm	
Warping constants	$I_{\omega,s}$	568900000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	92160000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	5824.66	mm^3	in distance 30 mm
	$W_{y,min}$	-5824.66	mm^3	in distance -30 mm
	$W_{z,max}$	6677.02	mm^3	in distance 20 mm
	$W_{z,min}$	-6677.02	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	68330.62	mm^4	in node 14
	$W_{\omega,M,min}$	-68363.94	mm^4	in node 1
Torsional section modulus	W_t	423.8	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B27: Querschnittseigenschaften der Müpro-Schienen MPC 40/60, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	455.97	mm^2	
	A_{geom}	455.97	mm^2	geometric (not ideal)
Shear areas	A_y	54.9	mm^2	
	A_z	316.16	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.75	mm	
Moments of inertia	I_y	184239.22	mm^4	about centroidal axes y, z
	I_z	134219.45	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	318458.67	mm^4	
	$I_{p,M}$	1894000.0	mm^4	about shear center M
Radii of gyration	i_y	20.1	mm	relative to centroid C
	i_z	17.16	mm	
Polar radii of gyration	i_p	26.43	mm	
	$i_{p,M}$	64.45	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	7.0	mm	
Cross-section weight	G	3.6	kg/m	
Cross-section perimeter	U	315.97	mm	incl. inner side of cells
Torsional constant	I_t	1271.37	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	161415.27	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	59.54	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	58.79	mm	
Warping constants	$I_{\omega,s}$	557500000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	92820000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	6298.85	mm^3	in distance 29.25 mm
	$W_{y,min}$	-5991.45	mm^3	in distance -30.75 mm
	$W_{z,max}$	6710.97	mm^3	in distance 20 mm
	$W_{z,min}$	-6710.97	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	68754.08	mm^4	in node 14
	$W_{\omega,M,min}$	-68786.79	mm^4	in node 1
Torsional section modulus	W_t	423.79	mm^3	
Stability parameters	r_u	-1.18	mm	
	$r_{m,v}$	-118.76	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B28: Querschnittseigenschaften der Müpro-Schienen MPC 40/60, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	494.97	mm^2	
	A_{geom}	494.97	mm^2	geometric (not ideal)
Shear areas	A_y	55.11	mm^2	
	A_z	309.81	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	2.94	mm	
Moments of inertia	I_y	211932.99	mm^4	about centroidal axes y, z
	I_z	134768.7	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	346701.68	mm^4	
	$I_{p,M}$	1926000.0	mm^4	about shear center M
Radii of gyration	i_y	20.69	mm	relative to centroid C
	i_z	16.5	mm	
Polar radii of gyration	i_p	26.47	mm	
	$i_{p,M}$	62.37	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.96	mm	
Cross-section weight	G	3.9	kg/m	
Cross-section perimeter	U	335.97	mm	incl. inner side of cells
Torsional constant	I_t	1288.36	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	161296.8	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	59.42	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	56.48	mm	
Warping constants	$I_{\omega,s}$	524000000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	93350000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	7831.28	mm^3	in distance 27.06 mm
	$W_{y,min}$	-6434.37	mm^3	in distance -32.94 mm
	$W_{z,max}$	6738.43	mm^3	in distance 20 mm
	$W_{z,min}$	-6738.43	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	69095.05	mm^4	in node 14
	$W_{\omega,M,min}$	-69125.38	mm^4	in node 1
Torsional section modulus	W_t	429.45	mm^3	
Stability parameters	r_u	-5.0	mm	
	$r_{m,v}$	-117.95	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B29: Querschnittseigenschaften der Müpro-Schienen MPC 40/60, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	478.08	mm^2	
	A_{geom}	478.08	mm^2	geometric (not ideal)
Shear areas	A_y	48.78	mm^2	
	A_z	312.53	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	2.03	mm	
Moments of inertia	I_y	200474.01	mm^4	about centroidal axes y, z
	I_z	134361.74	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	334835.74	mm^4	
	$I_{p,M}$	1914000.0	mm^4	about shear center M
Radii of gyration	i_y	20.48	mm	relative to centroid C
	i_z	16.76	mm	
Polar radii of gyration	i_p	26.46	mm	
	$i_{p,M}$	63.27	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.97	mm	
Cross-section weight	G	3.8	kg/m	
Cross-section perimeter	U	337.96	mm	incl. inner side of cells
Torsional constant	I_t	1181.1	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	161170.79	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	59.51	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	57.47	mm	
Warping constants	$I_{\omega,s}$	537600000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	92960000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	7168.43	mm^3	in distance 27.97 mm
	$W_{y,min}$	-6258.21	mm^3	in distance -32.03 mm
	$W_{z,max}$	6718.09	mm^3	in distance 20 mm
	$W_{z,min}$	-6718.09	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	68843.7	mm^4	in node 14
	$W_{\omega,M,min}$	-68874.95	mm^4	in node 1
Torsional section modulus	W_t	393.7	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B30: Querschnittseigenschaften der Müpro-Schienen MPC 40/80, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	563.97	mm^2	
	A_{geom}	563.97	mm^2	geometric (not ideal)
Shear areas	A_y	46.76	mm^2	
	A_z	425.34	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.0	mm	
Moments of inertia	I_y	378385.79	mm^4	about centroidal axes y, z
	I_z	174700.45	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	553086.24	mm^4	
	$I_{p,M}$	4141000.0	mm^4	about shear center M
Radii of gyration	i_y	25.9	mm	relative to centroid C
	i_z	17.6	mm	
Polar radii of gyration	i_p	31.32	mm	
	$i_{p,M}$	85.68	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.77	mm	
Cross-section weight	G	4.4	kg/m	
Cross-section perimeter	U	387.97	mm	incl. inner side of cells
Torsional constant	I_t	1631.41	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	210044.2	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	79.76	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	79.76	mm	
Warping constants	$I_{\omega,s}$	1303000000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	189600000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.008		
Section moduli	$W_{y,max}$	9459.64	mm^3	in distance 40 mm
	$W_{y,min}$	-9459.64	mm^3	in distance -40 mm
	$W_{z,max}$	8735.02	mm^3	in distance 20 mm
	$W_{z,min}$	-8735.02	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	103416.38	mm^4	in node 14
	$W_{\omega,M,min}$	-103500.0	mm^4	in node 1
Torsional section modulus	W_t	543.8	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B31: Querschnittseigenschaften der Müpro-Schienen MPC 40/80, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	575.97	mm^2	
	A_{geom}	575.97	mm^2	geometric (not ideal)
Shear areas	A_y	46.97	mm^2	
	A_z	426.29	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	0.8	mm	
Moments of inertia	I_y	395811.09	mm^4	about centroidal axes y, z
	I_z	175379.45	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	571190.54	mm^4	
	$I_{p,M}$	4147000.0	mm^4	about shear center M
Radii of gyration	i_y	26.21	mm	relative to centroid C
	i_z	17.45	mm	
Polar radii of gyration	i_p	31.49	mm	
	$i_{p,M}$	84.86	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.78	mm	
Cross-section weight	G	4.5	kg/m	
Cross-section perimeter	U	395.97	mm	incl. inner side of cells
Torsional constant	I_t	1631.37	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	209917.66	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	79.6	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	78.8	mm	
Warping constants	$I_{\omega,s}$	1282000000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	190700000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.008		
Section moduli	$W_{y,max}$	10097.84	mm^3	in distance 39.2 mm
	$W_{y,min}$	-9700.69	mm^3	in distance -40.8 mm
	$W_{z,max}$	8768.97	mm^3	in distance 20 mm
	$W_{z,min}$	-8768.97	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	103973.15	mm^4	in node 14
	$W_{\omega,M,min}$	-104000.0	mm^4	in node 1
Torsional section modulus	W_t	543.79	mm^3	
Stability parameters	r_u	-0.97	mm	
	$r_{m,v}$	-158.56	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B32: Querschnittseigenschaften der Müpro-Schienen MPC 40/80, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	614.97	mm^2	
	A_{geom}	614.97	mm^2	geometric (not ideal)
Shear areas	A_y	47.13	mm^2	
	A_z	423.2	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	3.19	mm	
Moments of inertia	I_y	447747.76	mm^4	about centroidal axes y, z
	I_z	175928.7	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	623676.46	mm^4	
	$I_{p,M}$	4202000.0	mm^4	about shear center M
Radii of gyration	i_y	26.98	mm	relative to centroid C
	i_z	16.91	mm	
Polar radii of gyration	i_p	31.85	mm	
	$i_{p,M}$	82.66	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.75	mm	
Cross-section weight	G	4.8	kg/m	
Cross-section perimeter	U	415.97	mm	incl. inner side of cells
Torsional constant	I_t	1648.36	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	209850.49	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	79.47	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	76.28	mm	
Warping constants	$I_{\omega,s}$	1217000000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	191700000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.007		
Section moduli	$W_{y,max}$	12165.01	mm^3	in distance 36.81 mm
	$W_{y,min}$	-10366.02	mm^3	in distance -43.19 mm
	$W_{z,max}$	8796.43	mm^3	in distance 20 mm
	$W_{z,min}$	-8796.43	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	104422.24	mm^4	in node 14
	$W_{\omega,M,min}$	-104500.0	mm^4	in node 1
Torsional section modulus	W_t	549.45	mm^3	
Stability parameters	r_u	-4.27	mm	
	$r_{m,v}$	-156.83	mm	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B33: Querschnittseigenschaften der Müpro-Schienen MPC 40/80, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	598.08	mm^2	
	A_{geom}	598.08	mm^2	geometric (not ideal)
Shear areas	A_y	42.53	mm^2	
	A_z	424.85	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	2.2	mm	
Moments of inertia	I_y	426061.8	mm^4	about centroidal axes y, z
	I_z	175521.74	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	601583.54	mm^4	
	$I_{p,M}$	4182000.0	mm^4	about shear center M
Radii of gyration	i_y	26.69	mm	relative to centroid C
	i_z	17.13	mm	
Polar radii of gyration	i_p	31.72	mm	
	$i_{p,M}$	83.62	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	6.76	mm	
Cross-section weight	G	4.7	kg/m	
Cross-section perimeter	U	417.96	mm	incl. inner side of cells
Torsional constant	I_t	1541.1	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	209734.37	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	79.57	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	77.37	mm	
Warping constants	$I_{\omega,s}$	1244000000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	191000000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.007		
Section moduli	$W_{y,max}$	11270.27	mm^3	in distance 37.8 mm
	$W_{y,min}$	-10097.22	mm^3	in distance -42.2 mm
	$W_{z,max}$	8776.09	mm^3	in distance 20 mm
	$W_{z,min}$	-8776.09	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	104090.89	mm^4	in node 14
	$W_{\omega,M,min}$	-104100.0	mm^4	in node 1
Torsional section modulus	W_t	513.7	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B34: Querschnittseigenschaften der Müpro-Schienen MPC 38/48 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	279.23	mm^2	
	A_{geom}	279.23	mm^2	geometric (not ideal)
Shear areas	A_y	84.07	mm^2	
	A_z	140.74	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	12.0	mm	
Moments of inertia	I_y	61839.8	mm^4	about centroidal axes y, z
	I_z	72254.4	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	134094.2	mm^4	
	$I_{p,M}$	134094.2	mm^4	about shear center M
Radii of gyration	i_y	14.88	mm	relative to centroid C
	i_z	16.09	mm	
Polar radii of gyration	i_p	21.91	mm	
	$i_{p,M}$	21.91	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	14.13	mm	
Cross-section weight	G	2.19	kg/m	
Cross-section perimeter	U	302.11	mm	incl. inner side of cells
Torsional constant	I_t	635.92	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	62583.68	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	12.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	26780000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	26780000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2576.66	mm^3	in distance 24 mm
	$W_{y,min}$	-2576.66	mm^3	in distance -24 mm
	$W_{z,max}$	3802.86	mm^3	in distance 19 mm
	$W_{z,min}$	-3802.86	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	42264.26	mm^4	in node 14
	$W_{\omega,M,min}$	-42238.73	mm^4	in node 1
Torsional section modulus	W_t	199.06	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B35: Querschnittseigenschaften der Müpro-Schienen MPC 38/48 H, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	293.23	mm^2	
	A_{geom}	293.23	mm^2	geometric (not ideal)
Shear areas	A_y	84.55	mm^2	
	A_z	135.47	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	12.0	mm	
Moments of inertia	I_y	61854.09	mm^4	about centroidal axes y, z
	I_z	73046.56	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	134900.66	mm^4	
	$I_{p,M}$	134900.66	mm^4	about shear center M
Radii of gyration	i_y	14.52	mm	relative to centroid C
	i_z	15.78	mm	
Polar radii of gyration	i_p	21.45	mm	
	$i_{p,M}$	21.45	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	14.06	mm	
Cross-section weight	G	2.3	kg/m	
Cross-section perimeter	U	310.11	mm	incl. inner side of cells
Torsional constant	I_t	618.63	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	60415.12	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	12.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	26650000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	26650000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2577.25	mm^3	in distance 24 mm
	$W_{y,min}$	-2577.25	mm^3	in distance -24 mm
	$W_{z,max}$	3844.56	mm^3	in distance 19 mm
	$W_{z,min}$	-3844.56	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	42122.45	mm^4	in node 14
	$W_{\omega,M,min}$	-42098.22	mm^4	in node 1
Torsional section modulus	W_t	113.75	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B36: Querschnittseigenschaften der Müpro-Schienen MPC 38/48 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	338.73	mm^2	
	A_{geom}	338.73	mm^2	geometric (not ideal)
Shear areas	A_y	84.91	mm^2	
	A_z	140.76	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	12.0	mm	
Moments of inertia	I_y	61900.54	mm^4	about centroidal axes y, z
	I_z	73687.36	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	135587.9	mm^4	
	$I_{p,M}$	135587.9	mm^4	about shear center M
Radii of gyration	i_y	13.52	mm	relative to centroid C
	i_z	14.75	mm	
Polar radii of gyration	i_p	20.01	mm	
	$i_{p,M}$	20.01	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	14.05	mm	
Cross-section weight	G	2.7	kg/m	
Cross-section perimeter	U	329.11	mm	incl. inner side of cells
Torsional constant	I_t	639.86	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	62581.56	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	12.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	26780000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	26780000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2579.19	mm^3	in distance 24 mm
	$W_{y,min}$	-2579.19	mm^3	in distance -24 mm
	$W_{z,max}$	3878.28	mm^3	in distance 19 mm
	$W_{z,min}$	-3878.28	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	42263.41	mm^4	in node 14
	$W_{\omega,M,min}$	-42242.36	mm^4	in node 1
Torsional section modulus	W_t	199.06	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B37: Querschnittseigenschaften der Müpro-Schienen MPC 38/48 H, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	319.01	mm^2	
	A_{geom}	319.01	mm^2	geometric (not ideal)
Shear areas	A_y	70.88	mm^2	
	A_z	140.73	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	12.0	mm	
Moments of inertia	I_y	61874.8	mm^4	about centroidal axes y, z
	I_z	73212.43	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	135087.23	mm^4	
	$I_{p,M}$	135087.23	mm^4	about shear center M
Radii of gyration	i_y	13.93	mm	relative to centroid C
	i_z	15.15	mm	
Polar radii of gyration	i_p	20.58	mm	
	$i_{p,M}$	20.58	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	14.09	mm	
Cross-section weight	G	2.5	kg/m	
Cross-section perimeter	U	365.43	mm	incl. inner side of cells
Torsional constant	I_t	531.99	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	62632.98	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	12.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	26820000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	26820000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	0.0		
Section moduli	$W_{y,max}$	2578.12	mm^3	in distance 24 mm
	$W_{y,min}$	-2578.12	mm^3	in distance -24 mm
	$W_{z,max}$	3853.29	mm^3	in distance 19 mm
	$W_{z,min}$	-3853.29	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	42307.74	mm^4	in node 14
	$W_{\omega,M,min}$	-42285.36	mm^4	in node 1
Torsional section modulus	W_t	133.09	mm^3	
Reduction factor	λ_M	0.0	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B39

Tabelle B39: Querschnittseigenschaften der Müpro-Schienen MPC 38/80 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	442.27	mm^2	
	A_{geom}	442.27	mm^2	geometric (not ideal)
Shear areas	A_y	82.23	mm^2	
	A_z	275.22	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	20.0	mm	
Moments of inertia	I_y	263161.52	mm^4	about centroidal axes y, z
	I_z	121757.82	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	384919.34	mm^4	
	$I_{p,M}$	384919.34	mm^4	about shear center M
Radii of gyration	i_y	24.39	mm	relative to centroid C
	i_z	16.59	mm	
Polar radii of gyration	i_p	29.5	mm	
	$i_{p,M}$	29.5	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	16.58	mm	
Cross-section weight	G	3.5	kg/m	
Cross-section perimeter	U	428.25	mm	incl. inner side of cells
Torsional constant	I_t	1097.0	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114439.32	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	20.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	105800000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	105800000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.001		
Section moduli	$W_{y,max}$	6579.04	mm^3	in distance 40 mm
	$W_{y,min}$	-6579.04	mm^3	in distance -40 mm
	$W_{z,max}$	6408.31	mm^3	in distance 19 mm
	$W_{z,min}$	-6408.31	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	99510.69	mm^4	in node 17
	$W_{\omega,M,min}$	-99463.92	mm^4	in node 30
Torsional section modulus	W_t	256.0	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B40: Querschnittseigenschaften der Müpro-Schienen MPC 38/80 H, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	458.27	mm^2	
	A_{geom}	458.27	mm^2	geometric (not ideal)
Shear areas	A_y	82.7	mm^2	
	A_z	275.23	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	20.0	mm	
Moments of inertia	I_y	263182.86	mm^4	about centroidal axes y, z
	I_z	122663.15	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	385846.01	mm^4	
	$I_{p,M}$	385846.01	mm^4	about shear center M
Radii of gyration	i_y	23.96	mm	relative to centroid C
	i_z	16.36	mm	
Polar radii of gyration	i_p	29.02	mm	
	$i_{p,M}$	29.02	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	16.56	mm	
Cross-section weight	G	3.6	kg/m	
Cross-section perimeter	U	436.25	mm	incl. inner side of cells
Torsional constant	I_t	1097.0	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114438.47	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	20.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	105800000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	105800000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.001		
Section moduli	$W_{y,max}$	6579.57	mm^3	in distance 40 mm
	$W_{y,min}$	-6579.57	mm^3	in distance -40 mm
	$W_{z,max}$	6455.96	mm^3	in distance 19 mm
	$W_{z,min}$	-6455.96	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	99510.54	mm^4	in node 17
	$W_{\omega,M,min}$	-99465.4	mm^4	in node 30
Torsional section modulus	W_t	256.0	mm^3	
Reduction factor	λ_M	0.0	1/mm	

Tabelle B41: Querschnittseigenschaften der Müpro-Schienen MPC 38/80 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	510.27	mm^2	
	A_{geom}	510.27	mm^2	geometric (not ideal)
Shear areas	A_y	83.07	mm^2	
	A_z	275.24	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	20.0	mm	
Moments of inertia	I_y	263252.19	mm^4	about centroidal axes y, z
	I_z	123395.49	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	386647.68	mm^4	
	$I_{p,M}$	386647.68	mm^4	about shear center M
Radii of gyration	i_y	22.71	mm	relative to centroid C
	i_z	15.55	mm	
Polar radii of gyration	i_p	27.53	mm	
	$i_{p,M}$	27.53	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	16.54	mm	
Cross-section weight	G	4.01	kg/m	
Cross-section perimeter	U	454.25	mm	incl. inner side of cells
Torsional constant	I_t	1103.72	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114437.75	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	20.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	105800000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	105800000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.001		
Section moduli	$W_{y,max}$	6581.3	mm^3	in distance 40 mm
	$W_{y,min}$	-6581.3	mm^3	in distance -40 mm
	$W_{z,max}$	6494.5	mm^3	in distance 19 mm
	$W_{z,min}$	-6494.5	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	99508.77	mm^4	in node 15
	$W_{\omega,M,min}$	-99468.23	mm^4	in node 28
Torsional section modulus	W_t	256.0	mm^3	
Reduction factor	λ_M	0.0	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B43

Tabelle B43: Querschnittseigenschaften der Müpro-Schienen MPC 38/48 H, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	487.72	mm^2	
	A_{geom}	487.72	mm^2	geometric (not ideal)
Shear areas	A_y	71.59	mm^2	
	A_z	275.21	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	20.0	mm	
Moments of inertia	I_y	263213.75	mm^4	about centroidal axes y, z
	I_z	122852.6	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	386066.35	mm^4	
	$I_{p,M}$	386066.35	mm^4	about shear center M
Radii of gyration	i_y	23.23	mm	relative to centroid C
	i_z	15.87	mm	
Polar radii of gyration	i_p	28.13	mm	
	$i_{p,M}$	28.13	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	16.56	mm	
Cross-section weight	G	3.8	kg/m	
Cross-section perimeter	U	490.9	mm	incl. inner side of cells
Torsional constant	I_t	944.4	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	114512.87	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	20.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	105900000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	105900000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.001		
Section moduli	$W_{y,max}$	6580.34	mm^3	in distance 40 mm
	$W_{y,min}$	-6580.34	mm^3	in distance -40 mm
	$W_{z,max}$	6465.93	mm^3	in distance 19 mm
	$W_{z,min}$	-6465.93	mm^3	in distance -19 mm
Warping section moduli	$W_{\omega,M,max}$	99596.46	mm^4	in node 17
	$W_{\omega,M,min}$	-99554.01	mm^4	in node 30
Torsional section modulus	W_t	171.14	mm^3	
Reduction factor	λ_M	0.0	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B45

Tabelle B45: Querschnittseigenschaften der Müpro-Schienen MPC 40/120 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	887.94677	mm^2	
	A_{geom}	887.94677	mm^2	geometric (not ideal)
Shear areas	A_y	109.27319	mm^2	
	A_z	602.91439	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	30.0	mm	
Moments of inertia	I_y	1148293.0	mm^4	about centroidal axes y, z
	I_z	267080.9	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	1415374.0	mm^4	
	$I_{p,M}$	1415374.0	mm^4	about shear center M
Radii of gyration	i_y	35.96109	mm	relative to centroid C
	i_z	17.34315	mm	
Polar radii of gyration	i_p	39.92474	mm	
	$i_{p,M}$	39.92474	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	18.05671	mm	
Cross-section weight	G	7.0	kg/m	
Cross-section perimeter	U	589.93666	mm	incl. inner side of cells
Torsional constant	I_t	4069.554	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	252300.6	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	30.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	461475300.0	mm^6	relative to centroid C
	$I_{\omega,M}$	461475300.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.002		
Section moduli	$W_{y,max}$	19138.22	mm^3	in distance 60 mm
	$W_{y,min}$	-19138.22	mm^3	in distance -60 mm
	$W_{z,max}$	13354.04	mm^3	in distance 20 mm
	$W_{z,min}$	-13354.04	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	281186.7	mm^4	in node 14
	$W_{\omega,M,min}$	-281003.5	mm^4	in node 1
Torsional section modulus	W_t	539.99976	mm^3	
Reduction factor	λ_M	0.00184	1/mm	

Tabelle B46: Querschnittseigenschaften der Müpro-Schienen MPC 40/120 H, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	911.94677	mm^2	
	A_{geom}	911.94677	mm^2	geometric (not ideal)
Shear areas	A_y	109.80535	mm^2	
	A_z	602.92305	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	30.0	mm	
Moments of inertia	I_y	1148365.0	mm^4	about centroidal axes y, z
	I_z	268438.9	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	1416804.0	mm^4	
	$I_{p,M}$	1416804.0	mm^4	about shear center M
Radii of gyration	i_y	35.48585	mm	relative to centroid C
	i_z	17.15687	mm	
Polar radii of gyration	i_p	39.41578	mm	
	$i_{p,M}$	39.41578	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	18.04764	mm	
Cross-section weight	G	7.2	kg/m	
Cross-section perimeter	U	597.93667	mm	incl. inner side of cells
Torsional constant	I_t	4069.47	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	252298.9	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	30.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	461477400.0	mm^6	relative to centroid C
	$I_{\omega,M}$	461477400.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.002		
Section moduli	$W_{y,max}$	19139.42	mm^3	in distance 60 mm
	$W_{y,min}$	-19139.42	mm^3	in distance -60 mm
	$W_{z,max}$	13421.94	mm^3	in distance 20 mm
	$W_{z,min}$	-13421.94	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	281185.5	mm^4	in node 14
	$W_{\omega,M,min}$	-281007.2	mm^4	in node 1
Torsional section modulus	W_t	539.99976	mm^3	
Reduction factor	λ_M	0.00184	1/mm	

Tabelle B47: Querschnittseigenschaften der Müpro-Schienen MPC 40/120 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	989.94677	mm^2	
	A_{geom}	989.94677	mm^2	geometric (not ideal)
Shear areas	A_y	110.22984	mm^2	
	A_z	602.94647	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	30.0	mm	
Moments of inertia	I_y	1148599.0	mm^4	about centroidal axes y, z
	I_z	269537.4	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	1418136.0	mm^4	
	$I_{p,M}$	1418136.0	mm^4	about shear center M
Radii of gyration	i_y	34.06264	mm	relative to centroid C
	i_z	16.50075	mm	
Polar radii of gyration	i_p	37.84888	mm	
	$i_{p,M}$	37.84888	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	18.03919	mm	
Cross-section weight	G	7.77	kg/m	
Cross-section perimeter	U	611.93668	mm	incl. inner side of cells
Torsional constant	I_t	4103.446	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	252297.5	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	30.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	461479000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	461479000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.001		
Section moduli	$W_{y,max}$	19143.32	mm^3	in distance 60 mm
	$W_{y,min}$	-19143.32	mm^3	in distance -60 mm
	$W_{z,max}$	13476.87	mm^3	in distance 20 mm
	$W_{z,min}$	-13476.87	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	281179.5	mm^4	in node 14
	$W_{\omega,M,min}$	-281015.2	mm^4	in node 1
Torsional section modulus	W_t	539.99976	mm^3	
Reduction factor	λ_M	0.00185	1/mm	

Tabelle B49: Querschnittseigenschaften der Müpro-Schienen MPC 40/120 H, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	956.15077	mm^2	
	A_{geom}	956.15077	mm^2	geometric (not ideal)
Shear areas	A_y	97.56718	mm^2	
	A_z	602.90709	mm^2	
Centroid position	$y_{s,0}$	0.0	mm	relative to zero point
	$z_{s,0}$	30.0	mm	
Moments of inertia	I_y	1148469.0	mm^4	about centroidal axes y, z
	I_z	268723.5	mm^4	
Inclination of principal axes	α	0.0	°	clockwise
Polar moments of inertia	I_p	1417193.0	mm^4	
	$I_{p,M}$	1417193.0	mm^4	about shear center M
Radii of gyration	i_y	34.65744	mm	relative to centroid C
	i_z	16.76446	mm	
Polar radii of gyration	i_p	38.49916	mm	
	$i_{p,M}$	38.49916	mm	about shear center M
Warping radius of gyration	$i_{\omega,M}$	18.06192	mm	
Cross-section weight	G	7.5	kg/m	
Cross-section perimeter	U	649.91266	mm	incl. inner side of cells
Torsional constant	I_t	3589.445	mm^4	calculated analytically
Secondary torsional constant	$I_{t,s}$	252530.7	mm^4	
Location of the shear center	$y_{M,0}$	0.0	mm	relative to zero point
	$z_{M,0}$	30.0	mm	
	y_M	0.0	mm	relative to centroid C
	z_M	0.0	mm	
Warping constants	$I_{\omega,s}$	462335000.0	mm^6	relative to centroid C
	$I_{\omega,M}$	462335000.0	mm^6	about shear center M
Auxiliary value for warp rotation	$r_{\omega,M}$	-0.002		
Section moduli	$W_{y,max}$	19141.15	mm^3	in distance 60 mm
	$W_{y,min}$	-19141.15	mm^3	in distance -60 mm
	$W_{z,max}$	13436.17	mm^3	in distance 20 mm
	$W_{z,min}$	-13436.17	mm^3	in distance -20 mm
Warping section moduli	$W_{\omega,M,max}$	281561.3	mm^4	in node 14
	$W_{\omega,M,min}$	-281391.0	mm^4	in node 1
Torsional section modulus	W_t	361.07986	mm^3	
Reduction factor	λ_M	0.00173	1/mm	